The hidden costs of imposing minimum contributions to a global public good

Ecological Economics 227 (2025) 108346

Contents lists available at ScienceDirect

Ecological Economics

journal homepage: www.elsevier.com/locate/ecolecon

Analysis

The hidden costs of imposing minimum contributions to a global public good☆

Diya Abraham [a], Katarína Glejtková [b], Ondřej Krčál [b,*]

[a] University of Reading, Shinfield Rd, Reading RG6 6EL, United Kingdom
[b] Masaryk University, Lipová 41A, 60200 Brno, Czech Republic

ARTICLE INFO

Dataset link: Replication data for "The hidden costs of imposing minimum contributions to a global public good" (2nd R&R) (Original data)

JEL classification:
D64
C91
D72
Q54
H41

Keywords:
Minimum contribution level
Dictator game
Public goods game
Climate change

ABSTRACT

We study how different types of individuals respond to being forced to make a minimum contribution to a global public good. Participants in our experiment decide how much of their endowment to contribute towards offsetting CO2 emissions. We elicit their contributions when they are free to spend any amount of their endowment on carbon offsets and when they are forced to spend a certain minimum amount on it. We find that those who contribute more than the minimum before it is imposed contribute less overall once the minimum comes into effect. This is true for both a low and a high level of the minimum and appears to be driven in part by pessimistic beliefs about the contributions of others. We show that the lower minimum also reduces *overall* contributions relative to a situation with no minimum. We do not find evidence that having the level of the minimum determined through a majority vote rather than an exogenous procedure has any material impact on these results.

1. Introduction

The survival of the human race depends on our ability to work together to address global challenges such as climate change, resistance to antibiotics and global pandemics (e.g. COVID-19). Individual efforts to reduce the severity of such problems, for instance by recycling or avoiding social gatherings (during a pandemic), can be seen as contributions to different global public goods. Unfortunately, given the scale of these challenges, the benefit of any *individual* contribution is effectively zero. Moreover, in the case of climate change mitigation, the true value of any collective endeavor will only become evident in the distant future. To tackle this challenge and inspire present-day participation, individuals are often forced through taxation, laws, or regulations to make a minimum contribution.[1] However, instituting such policies could backfire if citizens believe they curb individual freedoms. This concern is supported by recent studies revealing adverse effects of well-intended minimum contribution policies across various global public goods contexts (Betsch and Böhm, 2016; Schmelz, 2021; Schmelz and Bowles, 2021; Bansal et al., 2021; Velias et al., 2022).

☆ This output was supported by NPO "Systemic Risk Institute" number LX22NPO5101, funded by European Union - Next Generation EU (Ministry of Education, Youth and Sports, NPO: EXCELES) and the Czech Science Foundation grant GA 20-23131.

* Corresponding author.
E-mail addresses: d.e.abraham@reading.ac.uk (D. Abraham), 467466@mail.muni.cz (K. Glejtková), ondrej.krcal@econ.muni.cz (O. Krčál).

[1] Examples of policies that enforce a minimum level of contributions include mobility restrictions during a pandemic (Oh et al., 2021), regulations banning certain farming practices such as the use of antibiotics in farmed animals (Casewell et al., 2003; Simjee and Ippolito, 2022) and forbidding the use of incandescent light bulbs (Perino and Pioch, 2017). We view these regulations as enforcing minimum contributions because private citizens could make substantially larger contributions to these causes if desired. In a pandemic, for instance, one could stop all non-essential travel, wear a mask when meeting others, and get vaccinated but also encourage others to do the same. When it comes to climate change, people could choose to rely *solely* on energy-efficient devices, cut down on their meat consumption, avoid air travel, etc.

[2] Other terms that are used to describe the type of good we study are non-laboratory, real, real-world, or naturally occurring public goods (Weimann et al., 2022, footnote 2). Consistently with most studies dealing with climate change mitigation, we use the term *global public good*.

https://doi.org/10.1016/j.ecolecon.2024.108346
Received 26 February 2024; Received in revised form 31 July 2024; Accepted 8 August 2024
Available online 4 September 2024

In this paper, we conduct a controlled laboratory experiment to explore how imposing a minimum contribution to a global public good,[2] namely climate change mitigation, affects the behavior of different types of individuals in a society. To understand whether and how behavior is affected by agency in determining the level of the minimum, we vary how the minimum is set: exogenously through a random process or endogenously through a majority vote. Following recent literature on climate change (Andre et al., 2024; Huber et al., 2018; Gleue et al., 2024), we elicit individual contributions using a dictator game rather than the standard public goods game. This is partly because previous work has shown that contributions in abstract laboratory public goods games are only weakly linked to contributions to global public goods such as CO2 reduction (Goeschl et al., 2020; Weimann et al., 2022), but mainly because our goal is to simulate a situation in which a minimum policy in a given community is not Pareto improving but instead reduces the earnings of the members of that community. This reflects the idea that private citizens do not benefit materially from state or national policies enforcing a minimum contribution to curb climate change unless the policy can be enforced at a global level or at least among a fairly large coalition of countries.

Our experiment consists of two stages. In Stage 1, participants can contribute any amount of their laboratory endowment to purchase CO2 permits. This method of giving participants the opportunity to buy carbon offsets has been employed in several field experiments that study people's willingness to undertake costly actions to mitigate climate change (see e.g. Diederich and Goeschl, 2014, 2018; Löschel et al., 2017). In Stage 2, participants once again have the same endowment but this time their contribution choices are bounded below by a minimum. Specifically, their contributions are elicited under a low minimum regime, where they are forced to spend at least 10% of their endowment on carbon offsets, and a high minimum regime, where they are forced to spend at least 30% of their endowment on carbon offsets.

Prior to the commencement of Stage 1, participants are organized into groups of three. They are informed that at the end of the experiment, each group will review the photographs of its members alongside information about the portion of their endowment allocated to purchasing carbon offsets. This is a novel feature of our experiment. While in most economic experiments, researchers tend to maintain strict anonymity among participants to minimize social effects, in reality, identification is an important motivator for prosocial behavior. Harbaugh (1998) shows that charities are able to influence donations considerably by allowing donors to be identified. Similarly, Soetevent (2005) finds that when church donations can be observed by one's direct neighbors, the amount donated goes up by 10%. In laboratory studies, Rege and Telle (2004), Andreoni and Petrie (2004) and Farrow and Romaniuc (2019) find that revealing participants' photos or identities alongside their contribution decisions in a public goods game has a strong positive effect on voluntary contributions. Other experimental studies that have employed photos for identification include Coricelli et al. (2010) and Blaufus et al. (2017) who study the effect on tax evasion behavior. In our experiment, making contributions observable mirrors a specific facet of the real world, which is that climate-conscious choices (e.g. choosing a less meat-heavy diet, avoiding air travel, or purchasing climate-friendly household devices) are often observed by one's friends and neighbors. As evidenced from previous studies, the motivation to engage in these behaviors can be explained if people have social image concerns and derive positive utility from having others observe their prosocial actions while experiencing disutility from having others observe their shameful or more selfish choices (Lacetera and Macis, 2010; Butera et al., 2022). By rendering participants' contributions visible within their experimental groups across all of our treatments, we hoped to increase the proportion of participants contributing more than the MCLs in Stage 1 while simultaneously improving the external validity of our laboratory setting.

The division of subjects into groups of 3 is also necessary for the between-subject variation introduced in Stage 2 of the experiment: In this stage, half of the participants are assigned to the endogenous treatment where each member of the group votes on whether the low or high minimum contribution level (MCL) will be imposed in Stage 2. To avoid selection of climate conscious individuals into groups in which the high minimum wins, we have participants provide their contribution under both the low and the high MCL *before* learning about the outcome of the vote. The other half of our participants are assigned to the exogenous treatment where a random draw determines whether the low or high minimum regime is imposed on the group in Stage 2. For consistency, participants in the exogenous treatment also provide their contributions under both the low and high MCL before learning about the outcome of the random draw. After eliciting contributions in each Stage, we also elicit participants' predictions about the average contributions of the other two members of their group in that Stage and under each of the minimum regimes in Stage 2.

Our results reveal that the net effect of introducing a MCL in Stage 2 depends on *which* MCL is imposed: when the MCL is high (at 30% of participants' endowments), it has a net positive impact on contributions relative to Stage 1. However, when the MCL is set at 10% of participants' endowments, it has a net negative effect on contributions relative to Stage 1.

To better understand our results, we classified participants into two types depending on whether their contributions fell above or below a given MCL: participants whose Stage 1 contributions exceeded the relevant MCL imposed in Stage 2 are classified as "more generous", and those whose Stage 1 contributions was at or below the MCL imposed in Stage 2 were classified as "less generous". We find that across both the exogenous and endogenous treatments, both MCLs reduce the contributions of the more generous participants. In the case of the less generous participants, the MCLs simply serve to force their contributions up to the minimum but no further.

We do not find any support for a democratically determined minimum mitigating the negative effect of either MCL on the more generous participants. We further find that the more generous participants overestimate the drop in the average contributions of their group members. Since contributions are highly positively correlated with predictions in both Stage 1 and Stage 2, we posit that one potential reason for this drop in contributions is an overly pessimistic belief about one's group members' contributions once the MCL is introduced in Stage 2.

In light of the above analysis, we can now explain the overall effect of the low and high MCL. In case of the former, there were many participants whose Stage 1 contributions exceeded the MCL and subsequently fell once the MCL came into effect in Stage 2. This created a net negative effect of the MCL on overall contributions relative to Stage 1. However, when the higher MCL was imposed, there were now many more participants who fell into the less generous category and thus had their contributions forced *up* by the MCL. This resulted in a net positive effect of the MCL on overall contributions relative to Stage 1. These findings indicate that policy makers would do well to try and estimate the existing distribution of contributions in society before choosing the level of the minimum contribution to be imposed.

The experimental economics literature has modeled the willingness to cooperate to solve global social dilemmas in different ways. Buchan et al. (2009), who explore the effects of globalization on large-scale cooperation, employ a multi-level public-goods experiment in which participants from 6 different countries contribute to a local or global account thereby prioritizing cooperation with people from their own country or with a larger group composed of people from different countries. They find that individual and country-level measures of globalization are positively correlated with contributions to the global account. In other studies, participants' contributions reduce the risk that all the members of their group will incur a loss in the future (see for e.g. Santos and Pacheco, 2011; Tavoni et al., 2011; Barrett and Dannenberg, 2012). In one such study, Milinski et al. (2008) elicit

contributions towards an investment goal, the achievement of which serves to eliminate the risk that an "adverse event" wipes out the savings of the entire group. They find that even when the risk of this event is quite high (90%), only half of the groups (5 out of 10) manage to reach the investment goal. Hasson et al. (2010), employ a similar method except that in their study, the risk of an adverse climate event can only be reduced, never entirely eliminated, through the group's investment. This reflects the fact that at this point, we are unlikely to be able to fully mitigate the risks posed by climate change. Feige et al. (2018) model climate negotiations using a threshold public goods game with uncertain threshold value. They study the effect of using a unanimous voting procedure to agree on the level of a non-binding minimum and find that despite its non-binding nature, groups that reach an agreement on the minimum contribute more relative to a baseline without the voting procedure.

In contrast to the above experiments, we model contributions to climate change mitigation by eliciting participants' altruistic contributions to a non-profit that offsets CO2 emissions. Our study is similar to Milinski et al. (2006), who elicit participants' contributions to an ad campaign intended to increase awareness of climate change. This study finds that participants send non-zero amounts to the ad campaign (between 40% and 90% of their endowments), with contributions rising when they know their choices will be revealed to those who can influence their earnings in a separate dictator game. The incentives faced by individual participants in our experiment are also similar to that of the Intergenerational Goods Game (Hauser et al., 2014) in which members of a group (generation) can either extract a resource to exhaustion thereby maximizing their own payoffs but leaving nothing for the next generation – this would be akin to contributing nothing to offset CO2 emissions in our experiment – or they could refrain from extracting too much thus allowing the next generation to continue the game. In this type of setting, both voting (Hauser et al., 2014) and peer punishment (Lohse and Waichman, 2020) were found to be effective ways of increasing cooperative behavior.

In terms of the experimental treatments introduced, our design closely follows that of the experimental studies that investigate the impact of imposing a minimum contribution level in standard laboratory public goods games. Isaac and Norton (2013) and Martinsson and Persson (2019) find that an exogenously set 30% or 25% minimum contribution has a small positive effect on aggregate contributions in laboratory public good games. Kocher et al. (2016) studies the effect of two different minima in these games and finds that while the lower minimum (set at 10% of participants' endowments) does not increase aggregate contributions, the higher one (set at 35% of participants' endowment) does.[3] Similar to the current experiment, these three studies also employ a between-subject (Kocher et al., 2016; Martinsson and Persson, 2019) or within-subject (Isaac and Norton, 2013) comparison to investigate the impact of different institutional regimes to select the level of the minimum. Of the three, only Isaac and Norton (2013) report that an endogenously set MCL has a substantial positive effect on aggregate contributions. One reason could be that, unlike in the other two studies, Isaac and Norton (2013) report on aggregate behavior over several rounds instead of behavior in a one-shot game. Supporting this, Alt et al. (2023) show that an endogenously set minimum tends to have a ratchet effect, increasing contributions in successive rounds.

Given our use of the dictator game framework, our experiment is also closely related to studies investigating the impact of imposing minimum transfers in dictator games. Bolton and Katok (1998) and Eckel et al. (2005) use a between-subjects design contrasting transfers in dictator games that have a high and low minimum transfer imposed on the dictator. When both dictator and recipient are students in the experiment, Bolton and Katok (1998) find that imposing the higher minimum relative to the lower one reduces the voluntary transfers from dictator to recipient by 73.7%. Eckel et al. (2005) replace student recipients by a charity and find similar results when the minima are framed as a tax that will be deducted from their earnings and transferred to the charity. More recently, Barreiro-Hurle et al. (2023) used a framed field experiment with 600 farmers in Germany, Spain and Poland to study the effect of two different mandatory minimum transfers to the environment. In all of these studies, we note that the observed reduction in *voluntary* transfers can be attributed to participants in the role of dictator having their initial endowment reduced because of the mandatory minimum transfer. In contrast to these studies, when studying the behavior of participants classified as more generous in the current experiment, such distributional concerns should not play any role since these participants are, by definition, those who were contributing in excess of the minimum before it was imposed.

To our knowledge, the only other experiment that employs a dictator game to study one-to-one contributions to the environment while also exploring the effect of a democratic vs. autocratic institutional regime to select the level of the minimum is the lab-in-the-field experiment of Blanco et al. (2012). The authors of this study use a 3x2 between-subjects design with a no, low, and high minimum treatment and two ways of selecting the level of the minimum. Consistent with our results, they find evidence of crowding out of voluntary contributions and no difference when participants have more agency in the selection of the minimum. However, the statistical power of this study is low, recruitment procedures vary considerably by treatment, and there is a clear selection issue in the treatment in which participants can endogenously select the minimum. Besides overcoming these issues, the main advantage of our stage-based within-subject design is that it allows us to quantify the impact of a minimum on those who were previously contributing more as well as less than the minimum.

The remainder of this paper proceeds as follows: In Section 2, we detail our experimental design and hypotheses, Section 3 presents our results and Section 4 concludes.

2. Experimental design, procedures and hypotheses

2.1. Experimental design

At the beginning of the experiment, participants are randomly assigned to groups of three, which remain fixed for the duration of the experiment. They make their contribution choices in two stages of which one is randomly selected to be paid. They are aware that once the experiment concludes, their contribution choice in the stage that is selected to be paid will be shown to the other two members of their group along with their photographs and the number of the computer at which they were seated.

The two stages of the experiment are explained in detail below (see Fig. 1 for a graphic representation of the experimental design). The rules for Stage 2 were explained in detail only once participants completed Stage 1.

- *Stage 1*: In this stage, participants have CZK 1000 (≈ EUR 40) and decide how much of it they want to contribute to offset global CO2 emissions. They can contribute any amount from 0 to 1000 in multiples of 100. After making their choice, they are also asked to predict the average amount that will be contributed by the other two members of their group.
- *Stage 2*: This stage is similar to Stage 1 except this time participants' contributions are restricted by a minimum contribution level (MCL) of either 100 (or 10% of their endowment) or 300 (or 30% of their endowment). We elicit their choices under both MCLs but are aware that only one of these MCLs will be

[3] These results mirror the findings of the broader public goods literature that explores the impact of imposing taxes when eliciting public good contributions (see e.g. Andreoni, 1993; Chan et al., 2002; Gronberg et al., 2012; Kesternich et al., 2014, or for a recent meta-analysis, De Wit and Bekkers, 2017).

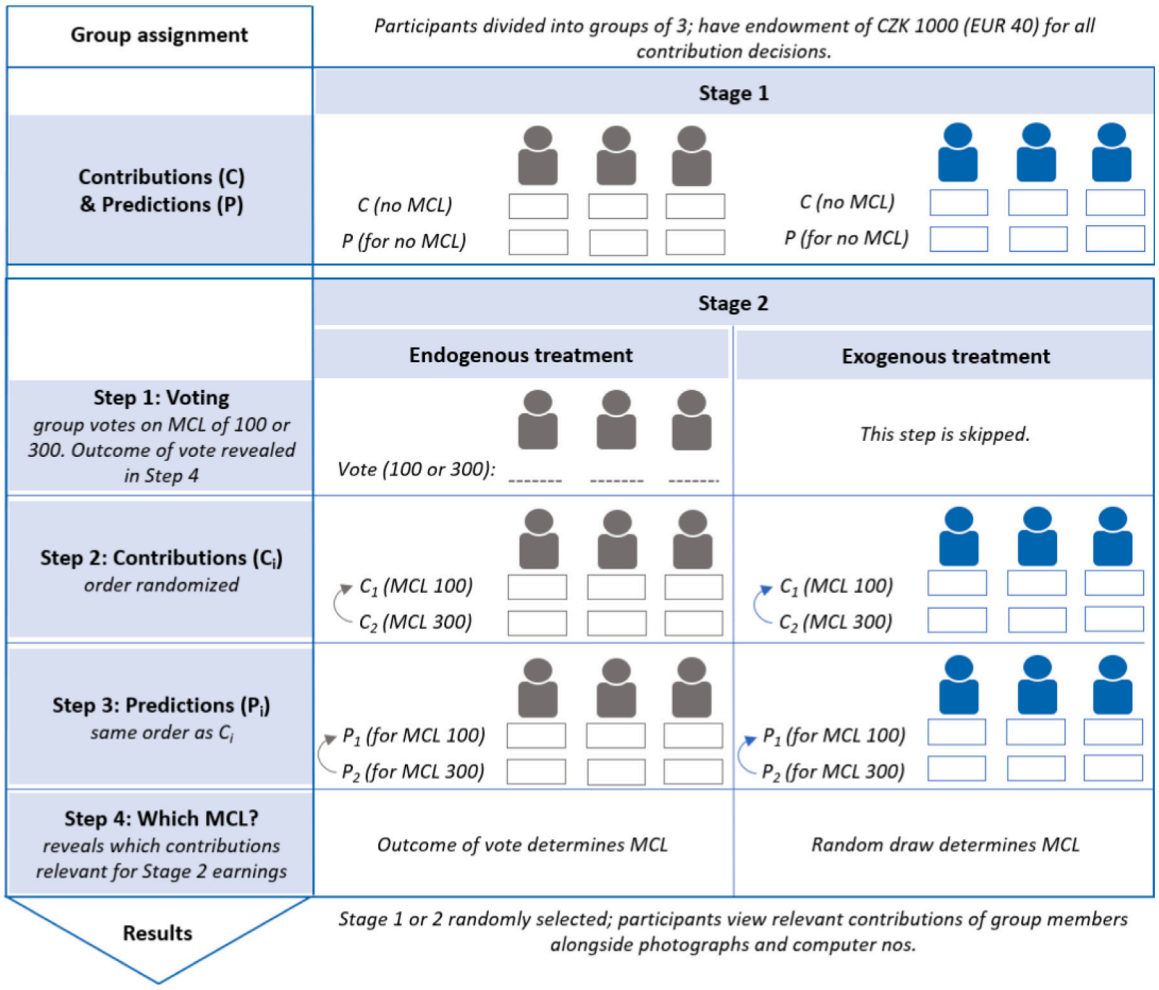

Fig. 1. Experimental Design.

implemented if Stage 2 is selected to be paid. After deciding how much to contribute under each MCL, they also predict the average amount that will be contributed by the other two members of their group under that MCL. In Stage 2, the order of contribution choices (i.e. under the MCL of 100 and 300) is randomized and predictions are elicited after each contribution choice. Our two between-subject treatments vary how the MCL in Stage 2 is selected:

- *Exogenous treatment*: Participants assigned to this treatment are informed that a *random mechanism* will determine which MCL is selected and thus which of their choices and predictions will be relevant for their earnings if Stage 2 is selected to be paid.
- *Endogenous treatment*: Participants assigned to this treatment are informed that a majority vote in their group will determine which MCL is selected. While the actual vote between the two MCLs precedes the participants' choices and predictions, they learn about the results of the vote only at the end of the experiment and thus have to make their choice under both MCLs *as though* it is the one that the majority of their group chose.

We follow Martinsson and Persson (2019) in first eliciting participants' Stage 1 contributions before introducing the minima in Stage 2 and keeping this order of the stages fixed for all participants. This order mimics a natural situation in which restrictions in the form of a minimum contribution are likely to be introduced as a way to increase contributions that are not restricted by any minimum.[4] Our choice *not* to randomize the order of the stages is supported by Kocher et al. (2016) who do randomize and find the results to be unaffected.

2.2. Experimental procedures

The experiment was conducted at the Masaryk University Experimental Economic Laboratory (MUEEL) in Brno, Czech Republic in November and December 2021 and June and September 2022. We recruited a total of 309 participants using hroot (Bock et al., 2014). The experiment was implemented in oTree (Chen et al., 2016) and all the instructions for the experiment appeared on participants' computer

[4] The data from participants' Stage 1 contribution choices further allow us to test whether the randomization into the endogenous and exogenous treatments in Stage 2 was successful (see Table 4).

screens. Appendix B contains the instructions and decision screens for the entire experiment.

On entering the laboratory, each participant had her/his photograph taken by the experimenter. Participants' photographs were used at the very end of the experiment and were deleted immediately thereafter. All participants consented to the use of their photographs for the experiment.

Once they had taken their seats, participants received some general information about Compensators, a non-profit that offers individuals and companies the opportunity to offset CO2 emissions by purchasing CO2 permits under the European Union Emission Trading Scheme (EU-ETS) and retiring them permanently. They were also informed that if they visited the MUEEL website at a specific date, they would be able to find the CO2 reduction certificate received from Compensators for an amount equivalent to the sum of participant contributions across all the experiment sessions run till that point.

Before making their choices, all participants answered a series of comprehension questions designed to improve their understanding of both the payment method as well as the kinds of choices they would be asked to make throughout the experiment. These comprehension questions were accompanied by detailed explanations if participants were not successful in their first attempt. The experiment continued only once all participants in the session had answered all the comprehension questions correctly.

At the end of the experiment, either Stage 1 or 2 was randomly selected to be paid. Once it was determined which stage would be paid, the choices of participants in that stage entered a lottery in which each participant had a 10% chance of winning and having their contribution choice implemented. This meant that if they won the lottery, the amount they chose to send Compensators in that Stage would be deducted from their endowment of CZK 1000 (≈ EUR 40) and they would leave the laboratory with the remaining amount. If they did not win the lottery, they received just the show-up fee plus a reward for an accurate prediction in the stage selected for payment (they could earn an additional CZK 50 (EUR 2) if their prediction did not differ by more than 100 from the actual average contribution of their group members).[5]

Our experiment was the first in a series of two unrelated experiments that were run within the same experimental session. Participants received information about the second experiment only after completing the first. At the end of both experiments, they received the information about which stage of the current experiment had been selected to be paid along with the information about which MCL was to be implemented (in case Stage 2 was selected to be paid), they were told whether they had won the payment lottery and then informed of their final earnings from the current experiment as well as the other experiment.

Participants received CZK 277 (EUR 11.7) on average for the entire session (approx. 90 min), and the average earnings for the current experiment were CZK 199 (EUR 8.4). The mean age of our sample was 22.3 years (StdDev 2.7), almost 70% were students of economics or business, and 47% were women.

[5] This method of incentivizing participants by having their contribution choices implemented with some probability is referred to as the Between-Subject Random Incentivization System (BRIS). We employed this method to increase the stakes for stand-alone choices. It permitted us, in each stage of the experiment, to have every choice involve a sum of approx. EUR 40. This amount is equal to approximately 8 h of unqualified labor in the Czech Republic and if fully utilized to purchase CO2 permits, it could at the time of the experiment, offset approximately 7% of the yearly CO2 emissions of the average Czech person. Clot et al. (2018) show in a dictator game that the BRIS method of incentivization does not significantly impact the outcomes compared to using a more standard pay-all method. We used it so that individual choices would feel more consequential given the relatively higher amount (EUR 40) that was involved.

Table 1
Impact of the minima on aggregate contributions of all participants.

	N	Stage 1 Mean (SD)	Stage 2 Mean (SD)	Stage 2–1 Mean (SE)
MCL = 100:				
- Contributions	309	343.7 (241.9)	320.4 (214.4)	−23.3 (6.2)***
- Predictions	309	362.6 (186.0)	285.8 (146.8)	−76.9 (8.2)***
MCL = 300:				
- Contributions	309	343.7 (241.8)	411.3 (159.7)	67.6 (7.6)***
- Predictions	309	362.6 (186.0)	422.3 (108.3)	59.7 (9.1)***

Notes: We have different contributions and predictions for the two MCLs only in Stage 2 where we elicit both levels with the strategy method. Stage 1 contributions are unrestricted by MCLs and therefore the same in both segments of the table. *, **, and *** indicate statistical significance of a two-sided paired t-test at the 10%, 5%, and 1% level, respectively.

2.3. Hypotheses

The four main pre-registered hypotheses concern only the participants classified as more generous with respect to the MCL of 100 (i.e., those who contributed more than 100 in Stage 1).[6] We did not pre-register hypotheses regarding the behavior of the less generous participants with respect to the MCL of 100 (i.e., those contributing equal to or less than 100 in Stage 1) because we predicted their contributions would only come up to the minimum of 100 in Stage 2.

Hypotheses H1a and H1b concern the contributions and predictions of the more generous participants with respect to the MCL of 100 in the exogenous treatment. We predicted that for these participants, exogenously setting a minimum contribution level would have adverse motivational effects in line with an aversion to having one's choice set deliberately restricted (Falk and Kosfeld, 2006). A drop in contributions from Stage 1 to Stage 2 may also be driven by a downward shift in the expected behavior of one's peer group (Young, 2015; Bicchieri, 2005).

H1a. *Relative to Stage 1, the exogenously imposed MCL of 100 in Stage 2 reduces the contributions of those participants whose Stage 1 contributions exceeded 100.*

H1b. *Relative to Stage 1, the exogenously imposed MCL of 100 in Stage 2 reduces the predictions of the more generous participants about the average amount contributed by the two other members of their group in Stage 2.*

Hypotheses H2a and H2b compare contributions in Stage 2 between the exogenous and endogenous treatments. Just as before, we restrict our sample to the more generous participants with respect to the MCL of 100. We predicted that the endogenous treatment would have a positive effect on Stage 2 contributions of these participants because they now had more control over the level of the MCL imposed, and might thereby derive greater intrinsic value from contributing more (Fehr et al., 2013; Bartling et al., 2014; Owens et al., 2014).

H2a. *In Stage 2 under the MCL of 100, the contributions of participants who contributed over 100 in Stage 1 are lower in the exogenous treatment compared to the endogenous treatment.*

H2b. *In Stage 2 under the MCL of 100, the predictions of the more generous participants about the average contributions of their group members are lower in the exogenous treatment compared to the endogenous treatment.*

Each of the four hypotheses above can be repeated for the MCL of 300 and in this case, only those participants who contributed over 300 in Stage 1 would fall into the category of more generous participants. Since there would naturally be fewer of these participants, we test the corresponding hypotheses on an exploratory basis.

[6] The pre-registered hypotheses and analysis plan can be found at https://aspredicted.org/L2W_GJW.

3. Results

In this section, we first explore whether and how the introduction of the minimum regimes in Stage 2 affects *aggregate* contributions relative to Stage 1. Then, in line with our pre-registered hypotheses, we separately consider the behavior and predictions of the more and less generous participants. We end by analyzing differences between the exogenous and endogenous treatments.

3.1. How does the minimum affect the aggregate contributions relative to Stage 1?

We first address the policy-relevant issue of the effect of the two MCLs on aggregate contributions. Table 1 summarizes the behavior and predictions of our entire sample in Stage 1 and Stage 2 of the experiment. We observe that while contributions and predictions (about others' contributions) drop from Stage 1 to Stage 2 under the MCL of 100, they increase under the MCL of 300. This is confirmed by paired t-tests in the last column of Table 1.

Result 1. The MCL of 100 has a negative impact on contributions and predictions. The MCL of 300 has a positive impact on contributions and predictions.

It is also clear from Table 1 that imposing a minimum reduces the variance in contributions, with standard deviations falling from 242 in Stage 1 to 214 when the MCL is 100 (F-test, two-sided, $p = 0.03$; Levene's test $p = 0.01$) and 160 when the MCL is 300 ($p < 0.001$ for both tests). Therefore, even though the lower MCL of 100 fails to increase contributions and in fact backfires in that it reduces overall contributions, this MCL as well as the higher MCL of 300 does serve to reduce the level of inequality in individual contributions.

3.2. How does imposing a minimum affect the behavior of more and less generous participants?

To gain deeper insights into what drove the net effects of the two minimum regimes, we follow our pre-registered hypotheses. We first focus only on participants in the exogenous treatment. Fig. 2 depicts their contribution behavior, with the x-axis denoting Stage 1 contributions and the y-axis representing Stage 2 contributions under the MCL of 100 (Panel A) and under the MCL of 300 (Panel B). The congruent scale of the axes positions participants contributing the same amount in Stage 1 and Stage 2 along the 45-degree line in both panels. The dark gray circles in both panels represent participants whose Stage 1 contribution exceeded the relevant MCL, i.e., those that fall into the category of more generous participants. For the MCL of 100 (Panel A), we observe that majority of participants (68%) fall into this category. The distribution below the 45-degree line in Panel A indicates a reduction in the contributions for this group from Stage 1 to Stage 2. In the case of participants in the less generous category with respect to the MCL of 100, we observe the necessary increase in their contributions to the minimum of 100, but not further. Indeed, only 1 in 15 participants in this category contributes more than 100 in Stage 2.

A similar pattern of behavior is observed for participants falling into the category of more and less generous with respect to the MCL of 300 (Panel B of Fig. 2). The difference is that under this MCL, there are fewer individuals who can be categorized as more generous (42%). The scatter plots thus reveal that regardless of which MCL is enforced, there is a negative effect on the more generous participants but only a muted positive effect on the less generous participants. This indicates that the net effect of any MCL will depend not only on the level of the minimum but also on the distribution of contributions above and below the minimum prior to it being introduced.

To test the statistical validity of the observations above, we first restrict our sample to participants in the exogenous treatment who contributed more than 100 in Stage 1 (see Table 2). Supporting H1a, we find a 10% drop in these participants' contributions from Stage 1 to Stage 2 under the MCL of 100 (paired t-test, one-sided, $p < 0.001$ and Wilcoxon signed-rank test, $p < 0.001$). This result remains significant at $p < 0.001$ even after (i) excluding participants who contributed the entirety of their endowment in Stage 1 or (ii) including those who contributed exactly the minimum of 100 in Stage 1.

Table 2
Impact of the minima on participants contributing over the minimum in Stage 1.

	N	Stage 1 Mean (SD)	Stage 2 Mean (SD)	Stage 2–Stage 1 Mean (SE)
MCL = 100:				
- Contributions	102	439 (188)	398 (181)	−41 (10.2)***
- Predictions	102	420 (151)	333 (134)	−87 (11.2)***
MCL = 300:				
- Contributions	63	552 (149)	521 (152)	−32 (10.3)***
- Predictions	63	480 (141)	459 (104)	−21 (18)

Notes: The data is restricted to participants in the exogenous treatment whose Stage 1 contribution exceeded the relevant MCL in Stage 2. *, **, and *** indicate statistical significance of a one-sided paired t-test at the 10%, 5%, and 1% level, respectively.

Next, exploring the behavior of only those participants whose Stage 1 contributions exceeded 300, we find that the MCL of 300 leads to a 6% reduction in the contributions of these participants. This drop in contributions from Stage 1 to Stage 2 is once again highly significant (paired t-test, one-sided, $p = 0.002$) despite the smaller size of the relevant sample (N = 63).

On comparing the Stage 1 and Stage 2 predictions about the contributions of one's group members, we also find support for H1b. The participants whose Stage 1 contributions exceed 100 correctly predict that the contributions of their group members will decrease when the MCL of 100 is imposed in Stage 2 (paired t-test, one-sided, $p < 0.001$ and Wilcoxon signed-rank test, $p < 0.001$). This more generous sub-sample of participants predicts that their group members will reduce their contributions by 20% (from the mean of 420 in Stage 1 to 333 in Stage 2). Meanwhile, their own contributions (i.e., the actual contributions of the more generous participants) dropped by just 10% from Stage 1 to Stage 2. We note here that these more generous participants were asked to provide their predictions of their group members' contributions before learning how much their group members had contributed in Stage 1. Given that the MCL would by design raise the contributions of the less generous participants, the prediction of a 20% *drop* in aggregate contributions is even more stark. In fact, the average contributions of *all* participants fell just by 3.7% from Stage 1 to Stage 2 under the MCL of 100.

There is a similar overestimation regarding the predicted drop in group members' contributions under the MCL of 300. Participants who fell into the more generous category with respect to the MCL of 300 predicted a 4.3% drop in their group members' contributions from Stage 1 to Stage 2 ($p > 0.1$). However, the actual average contributions of all participants in the exogenous treatment actually *increased* by 21.3% from Stage 1 and Stage 2 under the MCL of 300.

Result 2. The introduction of the MCL in Stage 2 reduces the average contributions and predictions of the more generous participants with respect to the relevant MCL.

Finally, we also find a strong positive correlation between participants' contributions and their predictions in the exogenous treatment (Pearson's correlation coefficient: 0.76 in Stage 1, 0.70 under the MCL of 100 and 0.46 under the MCL of 300). Together with the previous results concerning the drop in their predictions, this is evidence that participants who contributed generously in Stage 1 may have lowered their contributions because they believed that others in their group would do so as well. We note here that it is possible that own contribution behavior influenced predictions rather than the other way around. Since the direction of causality cannot be confirmed, we are careful not to over-interpret this finding.

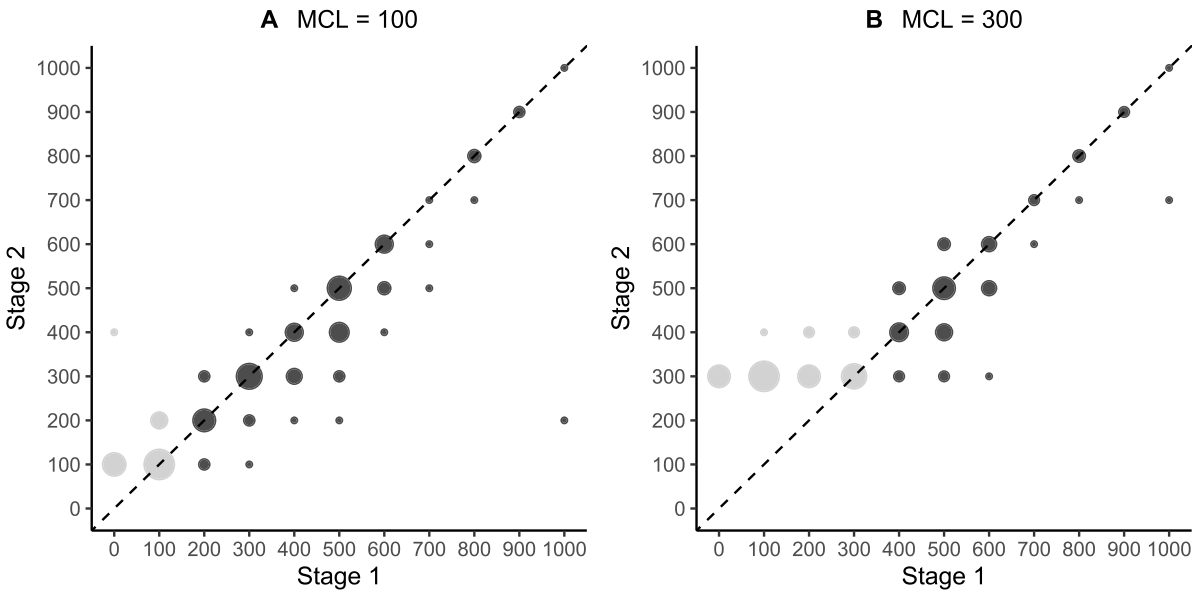

Fig. 2. Contributions in the exogenous treatment: Stage 1 vs. Stage 2.

Table 3
Factors correlated with voting decisions.

	(1) Voted for 100 (N = 78)	(2) Voted for 300 (N = 83)	(2)–(1)
Contributions in Stage 1	225.6	500.0	274.4 (32.8)***
Contributions in Stage 2 (MCL = 100)	201.3	456.8	255.5 (29.6)***
Contributions in Stage 2 (MCL = 300)	339.7	508.6	168.9 (23.4)***
Predictions in Stage 1	296.2	463.6	167.4 (27.4)***
Predictions in Stage 2 (MCL = 100)	237.2	330.2	93.1 (23.9)***
Predictions in Stage 2 (MCL = 300)	403.2	463.0	59.8 (18.1)***
Female	0.38	0.57	0.18 (0.08) **
Age (years)	22.1	22.6	0.48 (0.45)
Econ/Business major	0.71	0.64	−0.06 (0.07)

Notes: The data is restricted to participants in the endogenous treatment. The table shows means and standard errors in parentheses in the last column. *, **, and *** indicate statistical significance of two-sided t-tests or Fisher tests (binary variables) at the 10%, 5%, and 1% level, respectively.

Result 3. There is suggestive evidence that the negative response of the more generous contributors to the enforcement of a minimum is driven by pessimistic predictions about the contribution behavior of others in response to the same minimum.

3.3. Can the adverse effects of the minimum on more generous participants be mitigated by voting on the level of the minimum?

We will now investigate whether having a say in the level of the minimum mitigates the negative effect of the minimum on the more generous participants. In Stage 2, participants were asked for their contribution decisions under both the MCL of 100 and the MCL of 300. The payoff-relevant MCL was determined either by a random draw in the exogenous treatment or by a majority vote in the endogenous treatment.

First, we observe that 51% of the 159 participants assigned to the endogenous treatment voted for the higher MCL of 300.[7] In the exogenous treatment, the chance of the MCL of 300 being selected was set to 50%. Thus, the likelihood of the MCL of 300 being imposed was very similar between these two treatments.[8] Table 3 reveals clear differences in the behavior of participants who voted for the higher MCL over those who voted for the lower MCL: unsurprisingly, those who voted for the higher MCL contributed more overall. They were also more optimistic about the contributions of others in their group. The only demographic variable that appears significant in explaining voting choices is gender. In this respect, we find, similar to Martinsson and Persson (2019), that women are more likely to vote for the higher MCL.

Next, we test H2a and H2b, which deal with the impact of voting on the more generous participants. As before, we first restrict our sample to those who can be categorized as more generous with respect to the MCL of 100. As seen in the upper section of Table 4, the contributions in Stage 2 under the MCL of 100 are not significantly different between the endogenous and exogenous treatments (Contributions: 396 vs. 398, two-sided t-test, $p = 0.94$; Predictions: 332 vs. 309, two-sided t-test, $p = 0.23$). The middle section of Table 4 reveals a similar result for those classified as more generous with respect to the MCL of 300. These findings are confirmed by the regression analysis presented in Table 5, which also controls for Stage 1 contributions and demographic

[7] This result is in direct contrast with the finding of Blanco et al. (2012) who find that participants very rarely voted for the higher minimum in the endogenous treatments.

[8] The *realized* frequency of the MCL of 300 in the exogenous and endogenous treatments was 52% and 45%, respectively.

Table 4
Differences in exogenous and endogenous treatments.

	(1) Exogenous	(2) Endogenous	(2)−(1)
MCL = 100:	(N = 102)	(N = 124)	
Contributions in Stage 1	439.2	455.6	16.4 (26.0)
Contributions in Stage 2	398.0	396.0	−2.1 (26.5)
Predictions in Stage 1	420.1	429.8	9.7 (21.9)
Predictions in Stage 2	332.8	309.3	−23.6 (19.9)
MCL = 300:	(N = 63)	(N = 84)	
Contributions in Stage 1	552.4	553.6	1.2 (26.5)
Contributions in Stage 2	520.6	531.0	10.3 (27.0)
Predictions in Stage 1	480.2	491.1	10.9 (24.9)
Predictions in Stage 2	458.7	476.8	18.1 (18.4)
All data	(N = 150)	(N = 159)	
Contributions in Stage 1	320.7	365.4	44.7 (27.4)
Contributions in Stage 2 (MCL = 100)	308.6	331.4	22.7 (24.3)
Contributions in Stage 2 (MCL = 300)	396.0	425.8	29.8 (18.0)*
Predictions in Stage 1	342.7	381.4	38.8 (21.0)*
Predictions in Stage 2 (MCL = 100)	287.0	284.6	−2.4 (16.7)
Predictions in Stage 2 (MCL = 300)	410.3	433.6	23.3 (12.2)

Notes: This table displays means and standard errors in parentheses in the last column. The two upper segments use data from participants whose Stage 1 contributions exceed the MCLs of 100 and 300, respectively. *, **, and *** indicate statistical significance of two-sided t-tests at the 10%, 5%, and 1% levels.

Table 5
Effect of voting on contribution choices of the unconstrained contributors in Stage 2.

Dependent variable:	MCL = 100		MCL = 300	
	Contributions	Predictions	Contributions	Predictions
Endogenous	−20.00	−37.08**	8.86	13.65
	(15.18)	(18.33)	(16.07)	(19.10)
Contribution in Stage 1	0.92***	0.43***	0.93***	0.28***
	(0.04)	(0.05)	(0.05)	(0.06)
Female	12.11	−14.85	−5.09	5.40
	(15.35)	(18.51)	(16.45)	(19.54)
Age	5.49**	−0.08	2.21	3.03
	(2.75)	(3.34)	(3.00)	(3.56)
Econ/Business major	37.15**	6.42	24.46	−12.40
	(16.99)	(20.50)	(17.04)	(20.15)
Constant	−162.31**	147.85*	−58.88	238.26***
	(69.85)	(84.12)	(77.18)	(91.29)
Observations	225	225	146	146
Left/right censored	15/5	15/0	14/5	15/0

Notes: Tobit regressions with standard errors in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively. This table considers only participants who contributed over the respective MCL. The number of observations is reduced by one subject for whom we did not record socio-economic variables.

variables. We employ Tobit regressions to account for left censoring at the MCL and right censoring at 1000, which was the maximum amount that could be contributed.

Result 4. The opportunity to democratically determine which of the two MCLs should be imposed does not mitigate the negative impact on the more generous participants of having a minimum imposed in Stage 2.

3.4. Robustness

Given the fixed order of our within-subject treatments, we conducted an additional robustness check to ensure that the drop in contributions from Stage 1 to Stage 2 was not driven by the order in which participants provided their contributions, i.e., first in Stage 1 without a minimum and then in Stage 2, after a minimum was imposed. For instance, the drop in contributions of the more generous participants from Stage 1 to Stage 2 might have been caused not by the introduction of the minimum but by a moral licensing effect (Merritt et al., 2010; Jordan et al., 2011; Burger et al., 2022), wherein the participants who were more generous in Stage 1 felt entitled to contribute less in Stage 2.

To test this, we ran two additional sessions (N = 45) in which participants were asked to make the same unrestricted contribution decision twice in a row. As in the original experiment, participants did not receive feedback between the two decisions and knew that only one of these decisions would be randomly selected to be paid. We find that while there is a small drop in average contributions between the first and second decision, this is not significant at any conventional level (paired t-test, two-sided, $p = 0.6$). Moreover, most participants (64%) contributed exactly the same amount in both decisions, and a similar share of participants' contributions went up (16%) and down (20%).

Still, since both decisions were identical, it is somewhat surprising that 36% of participants chose to contribute a different amount in their second decision. Anticipating that a few participants might change their contribution choice, we included an open-ended question asking them to explain why they might have done so. Table A.1 shows the answers of all 16 participants who changed their contributions. There is little evidence of a lack of understanding about the payment method and little to no evidence to suggest the moral licensing effect at work. Instead, it appears that some participants simply changed their minds after the first decision or reported feeling like they would like to do something different in order to make the experiment more interesting.

Nevertheless, given the marginal drop in average contributions from the first to the second decision, we conduct a similar analysis to that done in the original experiment so as to make a more appropriate comparison between the two datasets. To do so, we consider only those participants in the new sessions who sent more than 100 in their first decision (N = 33). We note that while there are no significant differences between their first and second decisions (paired t-test, two-sided, $p = 0.2$), there are now more participants who decreased their contribution (24%) relative to those who increased it (15%). That said, there are also clear differences in comparison to the original data (N = 226) where only 4% increased their contribution while 34% decreased their contributions in response to the MCL of 100. These differences are apparent in Fig. A.1, which depicts the distribution of contributions in the original experiment (MCL = 100) alongside that of the additional two sessions. We conclude that while participants do appear to change their contribution choices when asked to make identical decisions sequentially, this is unlikely to fully explain the negative impact of imposing a minimum on the more generous participants in our sample.

4. Conclusion

We conducted an experiment to understand how enforcing a minimum standard of cooperative behavior would impact contributions to a global public good. We elicited participants' contributions towards offsetting global CO2 emissions with and without a minimum contribution obligation.

Our results highlight the importance of selecting the right *level* of a minimum mandate when it comes to global public good provision. We find that setting a high minimum contribution level increases overall contributions but that setting the minimum too low backfires in that it lowers aggregate contributions relative to a situation with no minimum. We also note that there is a reduction in the variance of contributions once a minimum is introduced. This suggests that if nothing else, a minimum mandate solely aimed at reducing the inequality of contributions will likely succeed.

Our experimental design further allowed us to evaluate how different types of contributors react to the minimum. We find that for those previously contributing less than the minimum, the introduction of the minimum just serves to bring their contributions up to the minimum and no further. For those contributing more than the minimum, we observe a strong negative impact of the minimum on contributions. The results from our endogenous treatment, wherein participants have the opportunity to vote on the level of the minimum, reveal that there is an almost identical effect of the minimum on both types of participants when they are allowed more say in the level of the minimum imposed.

We conjecture that one reason for the drop in the contributions is that the information contained in the minimum leads the more generous participants to believe they are contributing too much relative to their peers, i.e., in excess of what is dictated by the norm. Consistent with this, we also find they have overly pessimistic predictions regarding their group members' contributions. This suggests that it may be possible to leverage environmental contribution information to mitigate the negative effects on these more generous or civic-minded individuals when introducing a low minimum mandate. For instance, if these individuals receive factual information about their neighbors' contributions just after such a policy comes into effect, they are likely to be more optimistic about others' behavior, and thus keep their own contributions at the same level as before.[9] Our results also indicate that an approach to a minimum mandate that accounts for the efforts/contributions already being made by individuals is likely to be very useful in determining the level of the minimum contribution that will maximize aggregate contributions.

CRediT authorship contribution statement

Diya Abraham: Writing – review & editing, Writing – original draft, Supervision, Methodology, Investigation, Conceptualization. **Katarína Glejtková:** Methodology, Investigation, Funding acquisition, Data curation, Conceptualization. **Ondřej Krčál:** Writing – review & editing, Writing – original draft, Visualization, Software, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

Data availability

I have shared link to my data and code in the attach file step.

Replication data for "The hidden costs of imposing minimum contribu tions to a global public good" (2nd R&R) (Original data) (Mendeley Data).

[9] Supporting this type of intervention, a recent experiment by Andre et al. (2024) finds that providing a representative sample of US adults with correct information about the prevalence of climate-friendly behaviors raises individual willingness to combat climate change.

Table A.1
Contributions in Rounds 1 and 2 and reasons for the change.

Round 1	Round 2	Replies
600	500	i wanted to make diverse decisions because i am indecisive
500	600	There is no reason for it
1000	800	They did, I wanted to donate the most of given CZK 1000 for a good cause but I wanted to be playful and maybe hope I'd get 200 CZK for myself. I don't usually win loteries though, neither did I win now.
500	400	No particular reason - I wanted to contribute 450 but that was not possible, therefore I contributed 500 and 400
500	600	Because I wanted to contribute more
400	300	I did change it from higher to lower amount, just to put a different number in.
400	500	I had the impression that I could be more generous :-) [originally in Czech, translated]
600	400	I thought other team members would also contribute less.
100	300	I wanted to increase chance of other participants to win 50 Kč. And in second round I contributed more because I could not win probably.
500	600	i just tought about it deeper and told myself, that if I want to help my planet with CO2 polution, it is a good way. Mainly because the 1000 is not my now and i would be greatful even for 400
100	0	I just picked randomly, I didnt want to put the same ammount in both rounds
200	300	to make it more interesting
400	300	I thought that people's "fear" of being percieved as greedy would fall off a little in the second round, therefore making it a little more acceptable to donate less. I chose to donate less becuase im broke and I personally do not believe in carbon emision
500	300	I do not really know how to justify my decision. Perhaps I thought that maybe if I put in a different number, my chances of being correct would increase. But I could be wrong. No idea.
300	200	I guess its just my lust for the money and inexperience with gambling
100	300	I wanted a change. I decided to put more money to reduction.

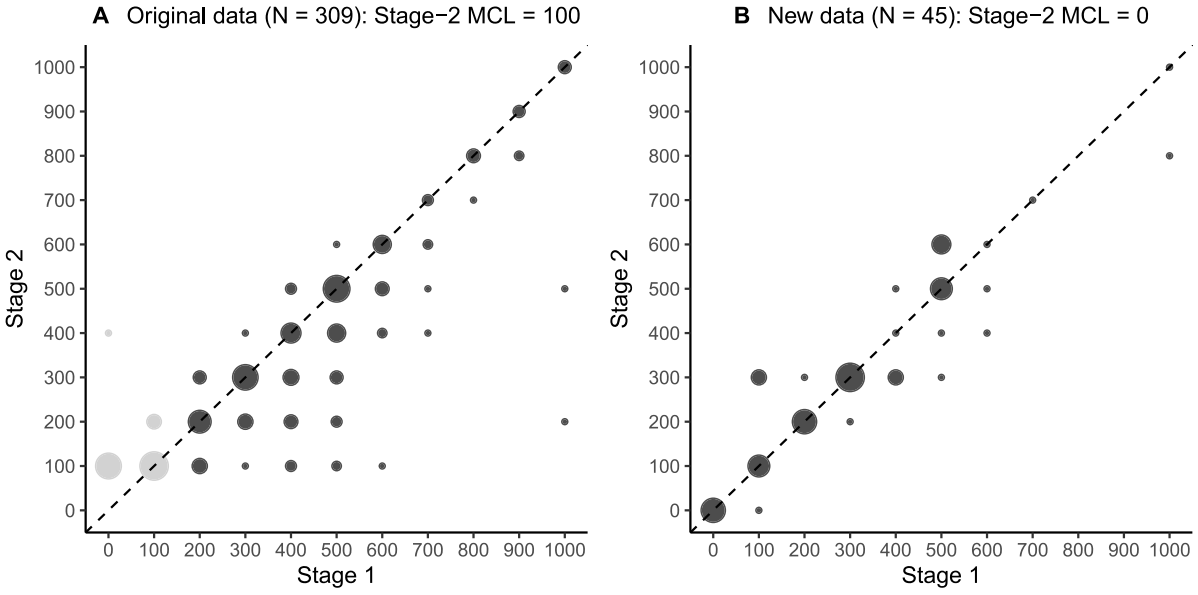

Fig. A.1. Comparison between the original and new data.

Appendix A. Additional data collection

The additional data was collected upon request of a reviewer in June 2024. We used the same subject pool and the same procedures (including the use of photographs) as in the original experiment. We note that participants in the additional sessions had similar Stage-1 contributions as those in the original experiment (mean contributions of 331 vs. 344, t-test, two-sided, $p = 0.75$).

Fig. A.1 depicts the distribution of both datasets. Panel A presents the data from the original experiment with MCL = 0 in Stage 1 and MCL = 100 in Stage 2. Panel B presents the data from two additional sessions with MCL = 0 in both stages.

Table A.1 provides data for the 16 participants who changed their contributions between stages. It contains contributions in Rounds 1 and 2 (stages were called rounds instead of parts A and B as in the original experiment) and full replies to the question "Rounds 1 and 2 were identical, and one of them was randomly selected to be paid. If your contributions changed between Round 1 and Round 2, please explain why?" from the post-experimental questionnaire.

Appendix B. Screenshots of the experimental environment

Introduction

Welcome. This session will contain three experiments. We will call them experiment 1, 2 and 3. The instructions for all experiments will appear on this screen.

Please do not communicate with other participants during the experiments. If you violate this rule, you will be excluded from the experiment and will forgo your payment. If you have a question, please raise your hand and we will come to your seat to answer your question privately.

Next

Experiment 1

In Experiment 1, you will make decisions concerning a sum of CZK 1000. You will be asked to make **several choices** about how much of this CZK 1000 to contribute to reduce global carbon dioxide (CO2) emissions and how much to keep for yourself. **At the end of the experiment, one of your choices** will be selected to enter a lottery, in which **there is a 10% chance of winning and having this choice paid for real.** In other words, there is a 10% probability that one of your contribution choices are actually used to reduce CO2 emissions. In this case, you will receive in cash whatever is remaining from the CZK 1000 after subtracting your contribution.

Regardless of whether or not you win the lottery described above, you will receive **a certain payment of CZK 100, which is your participation fee for Experiment 1.** We will also ask you to make several predictions about the choices of other participants in this session and reward you based on the accuracy of your predictions. These rewards will be added to your participation fee, so you will receive it regardless of the outcome of the lottery.

Why should we reduce CO2 emissions?

An increase in atmospheric CO2 (as well as other greenhouse gases), according to many scientists, results in global warming. Global warming can cause changes in weather, food production and water supplies. It can also result in droughts and increased spread of tropical diseases. These are only some of the possible harmful effects.

Emissions Trading Scheme by the European Union

The Emissions Trading Scheme (ETS) is an international trading system for CO2 created in 2005 by the European Union. It limits the maximum amount of greenhouse gases that companies in the energy production and other energy-intensive industries can emit. How does it work? The EU issues emission permits, which is a type of “right to emit”. For each unit of CO2 produced, a company

must have an emission permit (1 emission permit = 1 ton of emissions).

How can the company, 'Compensators' reduce CO2 emissions using the ETS?

Compensators is a charitable non-profit organization that was founded in 2006. Since its foundation, Compensators has offered individuals, companies and NGOs a way to reduce CO2 emissions by purchasing permits on the EU ETS.

With the donations it receives, Compensators buys emission permits from the EU ETS and decommissions them permanently. These allowances are then no longer available to industrial companies to cover their emissions. **Thus by buying an emission permit, any individual can effectively reduce CO2 emissions in the EU by 1 ton.**

For more information, you can visit https://www.compensators.org/ after the experiment is finished, or you can ask the experimenters about it.

How can you buy the permits?

As soon as you have completed reading this information, we offer you a chance to donate to Compensators to purchase permits. By donating your entire CZK 1000, it is possible to reduce CO2 emissions by a total of 750 kg. To provide a reference, 750 kg corresponds to ~7% of the yearly CO2 emissions of the average Czech person. If you win in the 1-in-10 lottery, your donation will be sent to Compensators who will use it (along with the donations of the other participants in this experiment) to buy emission permits.

How can you verify that your contribution was used to retire CO2 permits?

Compensators has created legal and operative barriers to ensure that all donations are used exclusively to purchase permits. This prevents your donation from being used for any other purpose. The transactions can be monitored transparently at this website: https://www.compensators.org/en/recent-donations/.

The transaction for this experiment will be carried out once all sessions for this experiment are completed, under the name of Katarína Glejtková (experimenter). The purpose will be stated as follows: *"MUEEL offsetting of CO2 emissions by participants in an experiment"*.

At the end of this study, a certificate of CO2 reduction will be posted on the official website of the Masaryk University Experimental Economics Laboratory (MUEEL): https://mueel.econ.muni.cz/en.

Next

Experiment 1

General instructions

All participants will be divided into groups of 3. This means you will be in a group with 2 other participants sitting in this room. Your group will consist of the same members throughout the whole experiment.

Each group member has CZK 1000 and has to make **several choices** about how much of the CZK 1000 to contribute to reduce global carbon dioxide (CO2) emissions and how much to keep for themselves. One of the choices of each group member will be selected to enter a lottery. In the lottery, each group member has a 10% chance that she/he will win, in which case the selected contribution will be used to reduce CO2 emissions and she/he will receive in cash whatever is remaining from the CZK 1000 after subtracting her/his contribution. We will also ask you to make several predictions about the choices of other participants in this session and reward you based on the accuracy of your predictions.

The lottery will work as follows: At the end of the experiment, the computer will randomly assign to each participant a number from 1 to 10, with each number being equally likely. If you imagine a bag in which there are 10 tokens numbered 1 to 10, then this random assignment by the computer essentially consists of the computer randomly drawing a token from this bag *for each participant in the experiment.*

If the number that the computer randomly draws for the participant is 1 then the participant wins the lottery and her/his selected contribution will be used to reduce CO2 emissions. In this case, the participant will receive a payoff equal to: **CZK 1000 – her/his contribution + the participation fee of CZK 100 + potential rewards for correct predictions.**

If the number that the computer randomly draws for you is between 2 and 10, then you ***do not win*** the lottery. In this case, you will not contribute to CO2 reduction, and you will obtain **only the participation fee of CZK 100 + potential rewards for correct predictions.**

The information of whether you have been selected in the lottery will be private. This means you will not know if one or more members of your group won the lottery and they will not know if you have won it.

The experiment will consist of two parts (Part A and Part B). We will explain the rules for each part in detail right before that part begins. **The computer will randomly decide whether the decisions from Part A or Part B are payoff relevant.** You will learn the outcome of this random draw at the end of the experiment. **This means that you should think carefully about your decisions in both Part A and Part B because either one of them could determine your contribution and your earnings from the experiment.**

Sequence of the experiment:

1. You make your contribution choices and predictions, first in Part A and then in Part B.

2.Random draw determines whether your choices in Part A or Part B will be payoff-relevant.

3. The computer will run a lottery. If you win, you contribute to CO2 reduction according to your choice in the payoff-relevant part and receive in cash whatever is remaining from the CZK 1000 after subtracting your contribution. Your predictions in the payoff-relevant part are paid regardless.

Payoffs

There are four possible outcomes:

1. You **win the lottery and Part A is randomly selected.** Then your contribution to reduce CO2 emissions will be taken from your choice in Part A. You will receive CZK 1000 – your contribution in Part A + your participation fee of CZK 100 + potential rewards for correct predictions in part A.

2. You **win the lottery and Part B is randomly selected.** Then your contribution to reduce CO2 emissions will be taken from your choice in Part B. You will receive CZK 1000 – your contribution in Part B + your participation fee of CZK 100 + potential rewards for correct predictions in Part B.

3. You **do not win the lottery and Part A is randomly selected.** Then your contribution to reduce CO2 emissions will be CZK 0, and you will just receive the participation fee of CZK 100 + potential rewards for correct predictions in part A.

4. You **do not win the lottery and Part B is randomly selected.** Then your contribution to reduce CO2 emissions will be CZK 0, and you will just receive the participation fee of CZK 100 + potential rewards for correct predictions in Part B.

Once you learn which is the payoff-relevant Part, you will also **see how much each member of your group contributed to reducing CO2 emissions in this payoff-relevant Part together with the photographs of your group members (in which they are holding their seat numbers)** that we took at the beginning of the experiment. Thus, before the lottery takes place, each group will see the photographs of each member of their group just above their respective contributions in the payoff-relevant Part.

Next

Comprehension questions:

In Part A, you will state the amount you would like to contribute to Compensators, ranging from CZK 0 to CZK 1000 (in steps of CZK 100). Before you make your choices, please answer the following comprehension questions. Please note that the numbers in the following hypothetical scenario were **randomly generated numbers between 0 and 1000** (in steps of CZK 100), and each number had an equal chance of being selected.

Hypothetical scenario

Suppose Part A is chosen by a random draw to be payoff-relevant. Your contribution in Part A is CZK 300. Let's call the other two players in your group players X and Y. The contribution of player X in Part A is CZK 500 and the contribution of player Y in Part A is CZK 800.

At the end of the experiment, you will see the contributions and photographs of:

You will see the contributions of your group members

What is the probability (in %) that you will win the lottery?

What will be your contribution to CO2 reduction (in CZK) if you win the lottery?

What will be your contribution to CO2 reduction (in CZK) if you do not win the lottery?

What is the minimum amount (in CZK) you will earn from the experiment if you win the lottery (including the CZK 100 participation fee but excluding any potential rewards for correct predictions)?

What is the minimum amount (in CZK) you will earn from the experiment if you do not win the lottery (including the CZK 100 participation fee but excluding any potential rewards for correct predictions)?

In the unlikely event that all members of your group win the lottery, what will be the total contribution of your group to CO2 reduction (in CZK)?

Next

Summary of instructions for Part A

In Part A, you will state the amount you would like to contribute to Compensators, ranging from CZK 0 to CZK 1000 (in steps of CZK 100).

Sequence of the experiment:

1. You make your contribution choices and predictions, first in Part A and then in Part B.

2. Random draw determines whether your choices in Part A or Part B will be payoff-relevant.

3. The computer will run a lottery. If you win, you contribute to CO2 reduction according to your choice in the payoff-relevant part and receive in cash whatever is remaining from the CZK 1000 after subtracting your contribution. Your predictions in the payoff-relevant part are paid regardless.

Part A:

The computer will randomly decide whether your choice and prediction in this part are payoff relevant. If Part A is chosen to be the *payoff-relevant* Part, the group will learn about the contribution decisions made by all three members of their group in Part A together with their photographs (in which they are holding their seat numbers) at the end of this session.

Next

Contribution

You have CZK 1000. Please indicate how much you want to contribute to buy CO2 permits and thus reduce global CO2 emissions.

You can choose any number between 0 and 1000 (in steps of 100).

Your contribution (CZK):

Next

Prediction

Please make a prediction about the average contribution of the other two members of your group in Part A. You can choose any number between 0 and 1000 (in steps of 50). If Part A is chosen to be the *payoff-relevant* Part and the difference, in absolute terms, between your prediction and the actual average contribution of the other two members of your group is not more than 100, then **CZK 50** will be added to your earnings.

In other words, you can earn an additional CZK 50 in Part A if your prediction of the average is not off by more than CZK 100.

Your prediction (CZK):

Next

Instructions for Part B

You are now in Part B of the experiment. Everything is the same as in Part A with one difference: There is now a minimum contribution of CZK 100 or 300. This means that you and the other group members need to contribute at least CZK 100 or 300. The actual minimum contribution will be determined by voting.

Next

Voting

All members of your group (including you) will now vote on the size of the minimum contribution. This means that you have to vote for one of the two minimum contributions: CZK 100 or CZK 300, which you prefer for your group. The minimum contribution that receives the majority of the votes (i.e., 2 or 3 votes) will be implemented in Part B and each member of your group will be able to contribute any amount from the selected minimum contribution up to CZK 1000.

Please vote by choosing the minimum contribution level of CZK 100 or CZK 300.

Your preferred minimum contribution is (CZK):

Next

Part B:

The computer will randomly decide whether your choices and predictions in this part are payoff relevant.

Now, we will ask you for your contribution decisions and predictions for two scenarios: one in which the minimum contribution level is set at CZK 100 (Scenario 100) and one in which the minimum contribution level was set at CZK 300 (Scenario 300). At the end of this session, you will learn which scenario was the true one i.e. you will learn which of these two minimum contribution levels was selected by majority voting in your group, and your contribution corresponding to that minimum will be implemented.

This means that if the minimum contribution level was selected to be CZK 100, your contribution choice corresponding to the minimum of 100 will be implemented and your contribution choice corresponding to the minimum of 300 will be irrelevant.

Similarly, if the minimum contribution level was selected to be CZK 300, your contribution choice corresponding to the minimum of 300 will be implemented and your contribution choice corresponding to the minimum of 100 will be irrelevant.

If Part B is selected to be the *payoff-relevant* Part, the group will learn about the contribution decisions made by all three members **for the selected minimum** together with their photographs (in which they are holding their seat numbers) at the end of this session.

Next

Your contribution in Scenario 300

The minimum contribution has been set at CZK 300. This means majority of the members in your group voted for the minimum of 300.

You have CZK 1000. Please indicate how much you want to contribute to buy CO2 permits and thus reduce global CO2 emissions.

You can choose any number between 300 and 1000 (in steps of 100).

Your contribution (CZK):

Next

Your contribution in Scenario 100

The minimum contribution has been set at CZK 100. This means majority of the members in your group voted for the minimum of 100.

You have CZK 1000. Please indicate how much you want to contribute to buy CO2 permits and thus reduce global CO2 emissions.

You can choose any number between 100 and 1000 (in steps of 100).

Your contribution (CZK):

Next

Your prediction in Scenario 300

Please make a prediction about the average contribution of the other two members of your group for the minimum of CZK 300.

You can earn an additional CZK 50 in Part B if your prediction of the average is not off by more than CZK 100.

Your prediction (CZK):

Next

Your prediction in Scenario 100

Please make a prediction about the average contribution of the other two members of your group for the minimum of CZK 100.

You can earn an additional CZK 50 in Part B if your prediction of the average is not off by more than CZK 100.

Your prediction (CZK):

Next

Results of experiment 1: Contributions

Here are the contributions of all players in your group together with their photographs. These contributions will enter the lottery.

You: 500 CZK

Player X: 500 CZK

Player Y: 700 CZK

Predictions

The average contribution of player X and Y is 600.0. Your prediction was 300. You are off by more than CZK 100, therefore you do not earn any reward for a correct prediction.

The results of your lottery will be shown in the following screen.

Next

References

Alt, M., Gallier, C., Kesternich, M., Sturm, B., 2023. Collective minimum contributions to counteract the ratchet effect in the voluntary provision of public goods. J. Environ. Econ. Manag. 122, 102895.

Andre, P., Boneva, T., Chopra, F., Falk, A., 2024. Misperceived social norms and willingness to act against climate change. Rev. Econ. Stat. 1–46.

Andreoni, J., 1993. An experimental test of the public-goods crowding-out hypothesis. Am. Econ. Rev. 1317–1327.

Andreoni, J., Petrie, R., 2004. Public goods experiments without confidentiality: a glimpse into fund-raising. J. Public Econ. 88 (7–8), 1605–1623.

Bansal, S., Khanna, M., Sydlowski, J., 2021. Incentives for corporate social responsibility in India: Mandate, peer pressure and crowding-out effects. J. Environ. Econ. Manag. 105, 102382.

Barreiro-Hurle, J., Dessart, F.J., Rommel, J., Czajkowski, M., Espinosa-Goded, M., Rodriguez-Entrena, M., Thomas, F., Zagorska, K., 2023. Willing or complying? The delicate interplay between voluntary and mandatory interventions to promote farmers' environmental behavior. Food Policy 120, 102481.

Barrett, S., Dannenberg, A., 2012. Climate negotiations under scientific uncertainty. Proc. Natl. Acad. Sci. 109 (43), 17372–17376.

Bartling, B., Fehr, E., Herz, H., 2014. The intrinsic value of decision rights. Econometrica 82 (6), 2005–2039.

Betsch, C., Böhm, R., 2016. Detrimental effects of introducing partial compulsory vaccination: experimental evidence. Eur. J. Public Health 26 (3), 378–381.

Bicchieri, C., 2005. The Grammar of Society: The Nature and Dynamics of Social Norms. Cambridge University Press.

Blanco, E., Lopez, M.C., Coleman, E.A., 2012. Voting for environmental donations: Experimental evidence from Majorca, Spain. Ecol. Econ. 75, 52–60.

Blaufus, K., Bob, J., Otto, P.E., Wolf, N., 2017. The effect of tax privacy on tax compliance–an experimental investigation. Eur. Account. Rev. 26 (3), 561–580.

Bock, O., Baetge, I., Nicklisch, A., 2014. hroot: Hamburg registration and organization online tool. Eur. Econ. Rev. 71, 117–120.

Bolton, G.E., Katok, E., 1998. An experimental test of the crowding out hypothesis: The nature of beneficent behavior. J. Econ. Behav. Organ. 37 (3), 315–331.

Buchan, N.R., Grimalda, G., Wilson, R., Brewer, M., Fatas, E., Foddy, M., 2009. Globalization and human cooperation. Proc. Natl. Acad. Sci. 106 (11), 4138–4142.

Burger, A.M., Schuler, J., Eberling, E., 2022. Guilty pleasures: Moral licensing in climate-related behavior. Global Environ. Change 72, 102415.
Butera, L., Metcalfe, R., Morrison, W., Taubinsky, D., 2022. Measuring the welfare effects of shame and pride. Amer. Econ. Rev. 112 (1), 122–168.
Casewell, M., Friis, C., Marco, E., McMullin, P., Phillips, I., 2003. The European ban on growth-promoting antibiotics and emerging consequences for human and animal health. J. Antimicrob. Chemother. 52 (2), 159–161.
Chan, K.S., Godby, R., Mestelman, S., Muller, R.A., 2002. Crowding-out voluntary contributions to public goods. J. Econ. Behav. Organ. 48 (3), 305–317.
Chen, D.L., Schonger, M., Wickens, C., 2016. oTree—An open-source platform for laboratory, online, and field experiments. J. Behav. Exp. Finance 9, 88–97.
Clot, S., Grolleau, G., Ibanez, L., 2018. Shall we pay all? An experimental test of random incentivized systems. J. Behav. Exp. Econ. 73, 93–98.
Coricelli, G., Joffily, M., Montmarquette, C., Villeval, M.C., 2010. Cheating, emotions, and rationality: an experiment on tax evasion. Exp. Econ. 13, 226–247.
De Wit, A., Bekkers, R., 2017. Government support and charitable donations: A meta-analysis of the crowding-out hypothesis. J. Public Administration Res. Theory 27 (2), 301–319.
Diederich, J., Goeschl, T., 2014. Willingness to pay for voluntary climate action and its determinants: Field-experimental evidence. Environ. Resour. Econ. 57 (3), 405–429.
Diederich, J., Goeschl, T., 2018. Voluntary action for climate change mitigation does not exhibit locational preferences. J. Environ. Econ. Manag. 90, 175–180.
Eckel, C.C., Grossman, P.J., Johnston, R.M., 2005. An experimental test of the crowding out hypothesis. J. Public Econ. 89 (8), 1543–1560.
Falk, A., Kosfeld, M., 2006. The hidden costs of control. Amer. Econ. Rev. 96 (5), 1611–1630.
Farrow, K., Romaniuc, R., 2019. The stickiness of norms. Int. Rev. Law Econ. 58, 54–62.
Fehr, E., Herz, H., Wilkening, T., 2013. The lure of authority: Motivation and incentive effects of power. Amer. Econ. Rev. 103 (4), 1325–1359.
Feige, C., Ehrhart, K.-M., Krämer, J., 2018. Climate negotiations in the lab: A threshold public goods game with heterogeneous contributions costs and non-binding voting. Environ. Resour. Econ. 70, 343–362.
Gleue, M., Harrs, S., Feldhaus, C., Löschel, A., 2024. Identity and voluntary efforts for climate protection. J. Econ. Behav. Organ. 221, 436–476.
Goeschl, T., Kettner, S.E., Lohse, J., Schwieren, C., 2020. How much can we learn about voluntary climate action from behavior in public goods games? Ecol. Econ. 171, 106591.
Gronberg, T.J., Luccasen III, R.A., Turocy, T.L., Van Huyck, J.B., 2012. Are tax-financed contributions to a public good completely crowded-out? experimental evidence. J. Public Econ. 96 (7–8), 596–603.
Harbaugh, W.T., 1998. The prestige motive for making charitable transfers. Am. Econ. Rev. 88 (2), 277–282.
Hasson, R., Löfgren, Å., Visser, M., 2010. Climate change in a public goods game: investment decision in mitigation versus adaptation. Ecol. Econ. 70 (2), 331–338.
Hauser, O.P., Rand, D.G., Peysakhovich, A., Nowak, M.A., 2014. Cooperating with the future. Nature 511 (7508), 220–223.
Huber, R.A., Anderson, B., Bernauer, T., 2018. Can social norm interventions promote voluntary pro environmental action? Environ. Sci. Policy 89, 231–246.
Isaac, R.M., Norton, D.A., 2013. Endogenous institutions and the possibility of reverse crowding out. Public Choice 156, 253–284.
Jordan, J., Mullen, E., Murnighan, J.K., 2011. Striving for the moral self: The effects of recalling past moral actions on future moral behavior. Personality Soc. Psychol. Bull. 37 (5), 701–713.
Kesternich, M., Lange, A., Sturm, B., 2014. The impact of burden sharing rules on the voluntary provision of public goods. J. Econ. Behav. Organ. 105, 107–123.
Kocher, M.G., Martinsson, P., Persson, E., Wang, X., 2016. Is there a hidden cost of imposing a minimum contribution level for public good contributions? J. Econ. Psychol. 56, 74–84.
Lacetera, N., Macis, M., 2010. Social image concerns and prosocial behavior: Field evidence from a nonlinear incentive scheme. J. Econ. Behav. Organ. 76 (2), 225–237.
Lohse, J., Waichman, I., 2020. The effects of contemporaneous peer punishment on cooperation with the future. Nat. Commun. 11 (1), 1815.
Löschel, A., Sturm, B., Uehleke, R., 2017. Revealed preferences for voluntary climate change mitigation when the purely individual perspective is relaxed–evidence from a framed field experiment. J. Behav. Exp. Econ. 67, 149–160.
Martinsson, P., Persson, E., 2019. Public goods and minimum provision levels: Does the institutional formation affect cooperation? Scand. J. Econ. 121 (4), 1473–1499.
Merritt, A.C., Effron, D.A., Monin, B., 2010. Moral self-licensing: When being good frees us to be bad. Soc. Personality Psychol. Compass 4 (5), 344–357.
Milinski, M., Semmann, D., Krambeck, H.-J., Marotzke, J., 2006. Stabilizing the Earth's climate is not a losing game: Supporting evidence from public goods experiments. Proc. Natl. Acad. Sci. 103 (11), 3994–3998.
Milinski, M., Sommerfeld, R.D., Krambeck, H.-J., Reed, F.A., Marotzke, J., 2008. The collective-risk social dilemma and the prevention of simulated dangerous climate change. Proc. Natl. Acad. Sci. 105 (7), 2291–2294.
Oh, J., Lee, H.-Y., Khuong, Q.L., Markuns, J.F., Bullen, C., Barrios, O.E.A., Hwang, S.-s., Suh, Y.S., McCool, J., Kachur, S.P., et al., 2021. Mobility restrictions were associated with reductions in COVID-19 incidence early in the pandemic: evidence from a real-time evaluation in 34 countries. Sci. Rep. 11 (1), 1–17.
Owens, D., Grossman, Z., Fackler, R., 2014. The control premium: A preference for payoff autonomy. Am. Econ. J. Microecon. 6 (4), 138–161.
Perino, G., Pioch, T., 2017. Banning incandescent light bulbs in the shadow of the EU emissions trading scheme. Climate Policy 17 (5), 678–686.
Rege, M., Telle, K., 2004. The impact of social approval and framing on cooperation in public good situations. J. Public Econ. 88 (7–8), 1625–1644.
Santos, F.C., Pacheco, J.M., 2011. Risk of collective failure provides an escape from the tragedy of the commons. Proc. Natl. Acad. Sci. 108 (26), 10421–10425.
Schmelz, K., 2021. Enforcement may crowd out voluntary support for COVID-19 policies, especially where trust in government is weak and in a liberal society. Proc. Natl. Acad. Sci. 118 (1), e2016385118.
Schmelz, K., Bowles, S., 2021. Overcoming COVID-19 vaccination resistance when alternative policies affect the dynamics of conformism, social norms, and crowding out. Proc. Natl. Acad. Sci. 118 (25), e2104912118.
Simjee, S., Ippolito, G., 2022. European regulations on prevention use of antimicrobials from january 2022. Braz. J. Veterinary Med. 44, e000822.
Soetevent, A.R., 2005. Anonymity in giving in a natural context—a field experiment in 30 churches. J. Public Econ. 89 (11–12), 2301–2323.
Tavoni, A., Dannenberg, A., Kallis, G., Löschel, A., 2011. Inequality, communication, and the avoidance of disastrous climate change in a public goods game. Proc. Natl. Acad. Sci. 108 (29), 11825–11829.
Velias, A., Georganas, S., Vandoros, S., 2022. COVID-19: Early evening curfews and mobility. Soc. Sci. Med. 292, 114538.
Weimann, J., Brosig-Koch, J., Heinrich, T., Hennig-Schmidt, H., Keser, C., 2022. CO2 emission reduction–real public good provision by large groups in the laboratory. J. Econ. Behav. Organ. 200, 1076–1089.
Young, H.P., 2015. The evolution of social norms. Economics 7 (1), 359–387.